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From: AAR-100, Aviation Maintenance Human Factors Program Manager
To: AFS-300, (POC: Rusty Jones)

Subj: Effects of fatigue/vigilance/environment on inspectors performing Fluorescent Penetrant and/or Magnetic Particle Inspections Execution Plan

Ref: (a) Aviation Maintenance TCRG recommendation (01/22/03)
(b) The National Transportation Safety Board (NTSB) issued Safety Recommendation A-98-17 as a result of the Delta/Pensacola accident.

As a result of the National Transportation Safety Boards investigation into the July 6, 1996, uncontained engine failure in Pensacola, Florida, of Delta Air Lines flight 1288, a McDonnell Douglas MD-88, Safety Recommendation *A-98-17* was issued to the FAA. This safety recommendation requests that the FAA, "conduct research to determine the optimum amount of time an inspector can perform nondestructive testing inspections (NDI) before human performance decrements can be expected." A research project studying NDI as a whole is very expensive, time consuming and hard to quantify, however the two primary methods of NDI that lend themselves to such a study are Liquid Penetrant and Fluorescent Magnetic Particle Inspection.

The project will be executed as follows:

Phase I tasks:

i. Comprehensive literature bibliography on Vigilance, Inspection, Fatigue and hours of work with special reference to factors known to affect performance on inspection tasks.

ii. Review data collected by Galaxy Scientific on hours of work and fatigue of maintenance personnel to extract data specifically on inspection. This will give a preliminary estimate of working durations by inspection task type.

iii. Interview inspection personnel, especially those in shop situations such as FPI and MPI, to determine distribution of working times and what strategies (e.g. rest breaks) are used to help combat fatigue.

iv. Review previous findings on typical inspection situations, e.g. FPI and MPI, to determine the visual and social environments actually encountered to determine if an additional data collection is required.

v. Design a series of experiments based on the above data and the input from the sponsor and aviation maintenance human factors program manager will be used to measure the effects of fatigue/vigilance/environment on inspection performance. Pre-test the experimental methodology using sample of inspectors. Both the factors to be varied and the measures to be taken will be specified.

vi. Defined milestones are (a) completion of report on comprehensive literature reviews on Vigilance, Inspection, Fatigue and hours of work (b) completion of report on findings for distribution of working times, fatigue strategies, inspection environments (c) completion of report on design of experiment and result of pre-tests.

vii. Quarterly (December, March, July, and September) research progress status reports
- Informal e-mail reports from the program manager aviation maintenance human factors to Rusty Jones (Aviation Maintenance TCRG representative).

viii. Phase I reports (to be published in the AAR-100 aviation maintenance human factors FY03 program review).
- Grantee will submit an annual report using AAR-100's Productivity Report website (http://www.hf.faa.gov/report/)

Phase II tasks:

i. Use design of experiments (DoE) procedures to run a screening experiment using the factors identified in Phase I using inspectors. These factors will consist of at least duration of work period, visual environment, social environment and scarcity of defects. For (n) factors a 2^n or $2^{(n-1)}$ experiment will be run to measure the presence of interactions between factors.

ii. Use design of experiments (DoE) procedures to run a series of parametric experiments to measure the exact effect of the significant factors from the screening experiment.

iii. Defined milestones are (a) completion of report on the screening experiment (b) completion of report on the parametric experiments and (c) completion of a Best Practices document to inform the aviation community of the potential problems associated with fatigue in combination with environment when performing these two inspection processes. This can serve to educate

the NDI community, and emphasize the need for regulating the time and individual spends performing these processes.

iv. Quarterly (December, March, July, and September) research progress status reports
    - informal e-mail reports from the program manager aviation maintenance human factors to Les Vipond

iv. Phase II reports (to be published in the AAR-100 aviation maintenance human factors FY04 program review).
    - Grantee will submit an annual report using AAR-100's Productivity Report website (http://www.hf.faa.gov/report/)

Deliverables:

Phase I:

i. report on comprehensive literature reviews on Vigilance, Inspection, Fatigue and hours of work
ii. report on findings for distribution of working times, fatigue strategies, inspection environments
iii. report on design of experiment and result of pre-tests

Phase II

iv. report on the screening experiment
v. report on the parametric experiments
vi. Best Practices document
vii. Final Report formatted to permit development of appropriate guidance material by AFS-300
    a. AFS-300 is responsible in submitting defined format to the program manager for aviation maintenance human factors by January 2005.

Schedule:

Phase I Tasks: FY03
Phase II Tasks: FY04/FY05
Final Report: FY05 (September 2005)

William K. Krebs